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# Studies in the Cleomaceae V: A New Genus and Ten New Combinations for the *Flora of North America*

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**ABSTRACT.** New combinations are made for 10 taxa previously included in the genus *Cleome* L. s.l. These are now considered to belong in the genera *Cleoserrata* Iltis, which is newly described herein, *Hemiscola* Rafinesque, *Peritoma* DC., and *Tarenaya* Rafinesque, as follows: *Cleoserrata serrata* (Jacquin) Iltis, *C. speciosa* (Rafinesque) Iltis, *H. diffusa* (Banks ex DC.) Iltis, *P. arborea* (Nuttall) Iltis, *P. arborea* var. *angustata* (Parish) Iltis, *P. arborea* var. *globosa* (Coville) Iltis, *P. jonesii* (J. F. Macbride) Iltis, *P. multicaulis* (Moçiño & Sessé ex DC.) Iltis, *P. platycarpa* (Torrey) Iltis, and *T. hassleriana* (Chodat) Iltis. A lectotype is designated for the basionym of *Cleoserrata speciosa*, *Cleome speciosa* Rafinesque.

**Key words:** Cleomaceae, *Cleome*, *Cleoserrata*, *Hemiscola*, North America, *Peritoma*, *Tarenaya*.

The genus *Cleome* L. s.l. comprises over 200 species, mainly in warm, often dry regions of Latin America, Africa, and to a lesser extent, the Near East and Australia (Heywood et al., 2007). Although highly diverse in the Neotropics, approximately three dozen species are recognized in our unpublished comprehensive synopsis of New World Cleomaceae as occurring in North America north of Mexico. Meanwhile, a new generic description and several new combinations are needed immediately for the treatment of the Cleomaceae for the *Flora of North America*.

As will be brought out in the synopsis, Iltis' studies have shown *Cleome* to be an assemblage of distinct groups of species better recognized at generic rank. Thus, the generic concept of *Cleome* will be drastically emended, which in the narrow sense is an Old World group typified by *C. ornithopodioides* L. Three species still being treated as belonging to *Cleome* s. str., *C. viscosa* L., *C. rutidosperma* DC., and *C. ornithopodioides*, as well as *Gynandropsis gynandra* (L.) Briquet, do occur within the geographic range of the *Flora of North America*, but all are weedy introductions.

**Cleoserrata** Iltis, gen. nov. TYPE: *Cleome serrata* Jacquin [= *Cleoserrata serrata* (Jacquin) Iltis].

Herbae annuae, herbaceae, glaberrimae, inermes. Folia palmatim ternata vel quinata vel septenata, foliolis ciliato-serrulatis, bracteis minimis, subuliformibus vel nullis. Flores speciosi, petalis ab splendide roseis ad purpurea vel ab eburneis raro ad alba, sub anthesi subaequalibus et erectis, ad basin attenuatis vel brevi- vel longi-unguiculatis. Seminibus fissura intus valde dilatata, invaginatione per membranam fissuralem conjuncta, membrana interdum cellulis carnuncularibus parvis inflatis oleosis oblecta.

Annual herbs, unarmed, sometimes fleshy-stemmed, glabrous, lacking spines. Leaves 3- or mostly 5- to 7-foliolate, leaflets minutely ciliate-serrulate; some species with minute, slender, hyaline stipules. Racemes bracteate to  $\pm$  ebracteate (i.e., the bracts none or reduced to minute, caducous, linear-lanceolate, hyaline, 1-nerved structures), glabrous, if glandular then with upwardly reduced, progressively small, green bracts. Sepals 4, free or slightly united at base; corolla closed in bud; petals 4, free, subequal, variable in color, shape, and size, brilliant pink to purple, ivory or rarely white, attenuate to short- or long-clawed; receptacular disk obsolete or slightly expanded, to 3 mm; androgynophore produced by the adhesion of filament bases to the epidermis of the gynophore base, 1–16 mm long; stamens 6, the anthers elongate, longitudinally dehiscent. Capsules ellipsoid, fusiform or linear-cylindrical, pendent, deflexed or erect, sessile or stipitate (gynophore); seeds many, the seed-cleft (in longitudinal section) narrow at mouth and greatly enlarged within, spherical, obovoid, or oblong, the invagination fused by a cleft-membrane covered in some species with a patch of small, inflated, oil-filled, caruncular cells (such cells lacking in *C. speciosa* and usually *C. serrata*).

As here construed, *Cleoserrata* includes glabrous annual herbs lacking spines or thorns and having a tendency to be ebracteate, having minutely serrulate leaf margins, and bearing showy pink to purple or ivory or white flowers, some with a definite androgynophore. It is segregated from *Cleome* partly on the basis of the unusual  $x = 12$  chromosomal complement ( $2n = 24$  [Pazy, pers. obs.; Przywara, pers. obs.], 48 [Pazy, pers. obs.; Przywara, pers. obs.]), and also from *Tarenaya* Rafinesque ( $2n = 20$  and numbers derived

therefrom [Breedlove, pers. obs.; Crosswhite, pers. obs.; Kawano, pers. obs.; Kowal, pers. obs.; Pazy, pers. obs.; Przywara, pers. obs.; Ruíz Zapata et al., 1996]) on the basis of molecular evidence suggesting that it constitutes a more basal clade than does that genus (Inda, pers. comm.). *Cleoserrata* includes five species that range from Mexico and the West Indies to Bolivia (Steinbach 5255, G-DEL, GH, MVM, NY) and northern Argentina (Jørgensen 3264, GH, LIL, SI, US): *Cleome melanosperma* S. Watson, *Cleome paludosa* Willdenow ex Eichler, *Cleoserrata* sp. ined. from east-central Brazil, and the following two, which are relevant to the *Flora of North America*.

- 1. *Cleoserrata serrata*** (Jacquin) Iltis, comb. nov.  
 Basionym: *Cleome serrata* Jacquin, Enum. Syst. Pl. 26. 1760. *Neocleome serrata* (Jacquin) Small, Man. S.E. Fl. 577. 1933. TYPE: Colombia: Cartagena, *N. J. von Jacquin s.n.* (holotype, BM).

*Cleoserrata serrata* is a common weedy species native from northern South America (Colombia: Killip & Smith 14903, GH, NY, US) to Mexico (Steere 1956, F, MEXU, MICH) and the West Indies (Cuba: Wright 1866, BM, GH, MO), and rarely introduced in the southern United States, i.e., Georgia (Small, 1933; Duncan & Kartesz, 1981). This species is distinguished by minute, hyaline stipules, open, few-flowered racemes that appear ebracteate, and often white petals (varying to yellowish, greenish, or purplish).

- 2. *Cleoserrata speciosa*** (Rafinesque) Iltis, comb. nov.  
 Basionym: *Cleome speciosa* Rafinesque, Fl. Ludov. 86. 1817. *Cleome speciosa* Kunth, Nov. Gen. Sp. (HBK) 5: 84, t. 436. 1821, nom. illeg. *Gynandropsis speciosa* (Kunth) DC., Prodr. (DC.) 1: 238. 1824, nom. illeg. TYPE: t. 436, Kunth, in Humboldt, Bonpland & Kunth, Nov. Gen. Sp. 5. 1821 (lectotype, designated here, t. 436, Kunth, 1821).

*Cleoserrata speciosa* is native to Mexico (Hinton 4725, BM, G, GH, MO, NY) but widely cultivated and occasionally escaped, e.g., throughout Central America (Guatemala: Heyde & Lux 3937, G, GH, M, MO, NY, US; Iltis, 2001) and the West Indies (Dominica: Eggers 825, G, L, M; Iltis, 2001), also northern South America (Colombia: Klug 1660, F, MO, NY), Louisiana (Hale s.n. [in 1880s], US) and Florida (Tracy 7667, CU, F, G, GH, ISC, MO, MSC, NEB, NY, US, WIS; Wunderlin, 1998), Africa (Kers, 1986), and the Orient (Ohashi, 1966).

It is fortuitous that both Rafinesque and Kunth should have chosen the same epithet, albeit an appropriate one, for this widespread, polymorphic

species, which is characterized by the usual lack of pubescence, 1-foliolate bracts, and large flowers with pink to deep purple (rarely white), narrowly long-clawed petals to 4 cm long and usually greatly elongated androgynophores. Kunth's 1821 description covers all these points and more, whereas Rafinesque's, being brief, is inadequate to convey much of an impression of the species being portrayed. However, the phrase "foliolis...ciliatis" (Rafinesque, 1817: 86) definitely points to *Cleoserrata*, and the additional information given, including raceme size, flower size and color, country of origin (Mexico), and popularity in cultivation, leaves no doubt that he was referring to *C. speciosa*. Because it shows flowers and fruits in correct detail and agrees unambiguously with the protologue, Kunth's illustration is well suited to be the lectotype of *Cleome speciosa* Rafinesque.

#### HEMISCOLA RAFINESQUE

Rafinesque (1838) segregated *Hemiscola* from *Cleome* s.l. and included only the spiny *H. aculeata* (L.) Rafinesque and the unrelated and ambiguous name "*ornithopoides* Raf." (1838: 111) (sic, *C. ornithopodioides* L.). Adopting a broader view of the genus, Iltis reckons that it encompasses fewer than 10 spiny species (and the rare unarmed forms) characterized by white to cream flowers in short, bracteate inflorescences or solitary in the axils of leaves and by horseshoe-shaped seeds that have the mouth of the cleft covered by a thin membrane, the tip of the radicular claw expanded into a large, white or ivory, funicular aril, and the testa transverse-wrinkled or irregularly tubercled, the ridges or excrescences sparsely pubescent on their crests with minute clusters of caducous white hairs. The chromosome number is  $2n = 18$  (Crosswhite, pers. obs.; Pazy, pers. obs.), derived by aneuploid reduction from  $2n = 20$  for *Tarenaya* (see under *Cleoserrata* above). The spininess suggests a relationship to *Tarenaya*, as do molecular data (Hall et al., 2002). This genus is entirely South American except for the widespread, weedy *H. aculeata*, which barely encroaches into the southern United States, i.e., southern Texas (Runyon 145, TEX) and Alabama (Mohr, 1901). A second species, the Brazilian *H. diffusa* (Banks ex DC.) Iltis, has been locally introduced into Alabama and is herein transferred to *Hemiscola*.

- 1. *Hemiscola diffusa*** (Banks ex DC.) Iltis, comb. nov.  
 Basionym: *Cleome diffusa* Banks ex DC., Prodr. (DC.) 1: 241. 1824. *Cleome aculeata* L. var. *diffusa* (Banks ex DC.) Kuntze, Revis. Gen. Pl. 3, pt. 2: 7. 1898. TYPE: Brazil, Rio de Janeiro: *J. Banks & D. C. Solander s.n.* (holotype, BM).

*Additional specimen examined.* U.S.A. **Alabama:** ballast grounds, Hunters Wharf, Mobile, 1893, *Mohr s.n.* (NY, US).

*PERITOMA* DC.

*Peritoma* was erected by DC. (1824) for a single, common, showy, and variable species, *P. serrulata* (Pursh) DC. (as *P. serrulatum*). Although *Peritoma* has been recognized from time to time in the past, most workers have preferred to keep *P. serrulata* in *Cleome* (e.g., Vanderpool, 1993; Holmgren & Cronquist, 2005). Iltis resurrects this generic name for de Candolle's species to include five others, clearly related, which share with it the following suite of characters: plants mostly annual, glabrous (pubescent only in *P. platycarpa* (Torrey) Iltis), and unarmed; leaflets 1–6 cm long, entire; flowers yellow or pink to purple or white, borne in the axils of leafy, 1- to 3-foliolate bracts; petals sessile or subsessile, more or less radially arranged in the open flower; anthers coiled when dry; and seed-cleft covered nearly the whole length by the testa or by a hard membrane, the cleft-cavity very long and narrow or obsolete. The chromosome numbers of *Peritoma* are  $2n = 32$  (Rollins, 1939; Ward & Spellenberg, 1988), 34 (Raven et al., 1965; Mulligan, 1966), 40 (Tiehm & Day, 1987), or rarely 60 (Mulligan, 1965), showing frequent reduction by aneuploidy (to  $2n = 32$  or 34) and suggesting tetraploidy from the ancient base number of  $x = 10$ . The genus is distributed primarily in deserts, semi-deserts, and grasslands across the northern half of Mexico and the western United States (Iltis, 1957) but reaches as far east as the Dakotas (Great Plains Flora Association, 1977) (and rarely beyond) and as far north as southern Canada (Scoggan, 1978). All six species, one comprising three varieties, occur in this region, necessitating the following new combinations.

**1. *Peritoma arborea*** (Nuttall ex Torrey & A. Gray) Iltis, comb. nov. Basionym: *Isomeris arborea* Nuttall, Fl. N. Amer. (Torrey & A. Gray) 1: 124. 1838. *Cleome isomeris* Greene, Pittonia 1(14): 200. 1888, replacement name for *Isomeris arborea* Nuttall, Fl. N. Amer. (Torrey & A. Gray) 1: 124. 1838, non *Cleome arborea* Kunth, Nov. Gen. Sp. (HBK) 5: 86. 1821. TYPE: U.S.A. California: St. Diego, s.d., *T. Nuttall s.n.* (holotype, BM, BM photo at WIS).

**1a. *Peritoma arborea*** (Nuttall ex Torrey & A. Gray) Iltis var. **arborea**.

**1b. *Peritoma arborea*** var. **angustata** (Parish) Iltis, comb. nov. Basionym: *Isomeris arborea* var. *angustata* Parish, Muhlenbergia 3: 128. 1907. TYPE: U.S.A. California: western edge of Colorado Desert, Palm Sprs., *S. B. Parish s.n.* (holotype, GH).

**1c. *Peritoma arborea*** var. **globosa** (Coville) Iltis, comb. nov. Basionym: *Isomeris arborea* var. *globosa* Coville, Proc. Biol. Soc. Wash. 7: 73. 1892. TYPE: U.S.A. California: Kern Co., Caliente Creek, a few mi. above Caliente, 24 June 1891, *F. V. Coville & F. Funston 1107* (holotype, US; isotype, US).

**2. *Peritoma jonesii*** (J. F. Macbride) Iltis, comb. nov. Basionym: *Cleome lutea* Hooker var. *jonesii* J. F. Macbride, Contr. Gray Herb. 65: 39. 1922. *Cleome jonesii* (J. F. Macbride) Tidestrom, Proc. Biol. Soc. Wash. 48: 39. 1935. TYPE: U.S.A. Arizona: Verde Valley, 24 July 1920, *W. W. Jones 168* (holotype, GH).

**3. *Peritoma lutea*** (Hooker) Rafinesque.

**4. *Peritoma multicaulis*** (Moçino & Sessé ex DC.) Iltis, comb. nov. Basionym: *Cleome multicaulis* Moçino & Sessé ex DC., Prodr. (DC.) 1: 240. 1824. TYPE: Mexico. "Fl. mex. Ic.," Sessé & Moçino Illustr. Hunt Inst. 6331.0918 (lectotype, designated by McVaugh, 2000: 117).

*Cleome sonorae* A. Gray, Pl. Wright. 2: 16. 1853. *Peritoma sonorae* (A. Gray) Rydberg, Bull. Torrey Bot. Club 33: 142. 1906. Syn. nov. TYPE: Mexico. Sonora: W of Chiricahui Mtns., 6 Sep. 1851, *C. Wright s.n.* (holotype, GH; isotypes, CGE, GH, MO).

**5. *Peritoma platycarpa*** (Torrey) Iltis, comb. nov. Basionym: *Cleome platycarpa* Torrey, U.S. Expl. Exped., Phan. 17(2): 235, t. 2. 1874, non *Cleome platycarpa* Schinz, Verh. Bot. Vereins Prov. Brandenburg 29: 50. 1888. *Celome platycarpa* (Torrey) Greene, Pittonia 4: 211. 1900. TYPE: U.S.A. California: northern California, Klamet River [sic], Oct. 1841, *W. D. Brackenridge & W. Rich [Wilkes Exped.] 1579* (lectotype, designated by Holmgren & Cronquist, 2005: 166, NY; isotype, US).

**6. *Peritoma serrulata*** (Pursh) DC.

*TARENAYA*

The majority of New World species classified in the genus *Cleome* comprise a very large and diverse group for which the name *Tarenaya* (Rafinesque, 1838: 111) is available. Extreme variation occurs in plant size and pubescence, flower color, and seed coat texture, but the typical presence of spines and bracts and characters of the disk and seeds unite these species.

The disks are obsolete or disciform or, if conic, nearly always only slightly developed. The cleft of the mature seed is covered for most of its length by a thin, fragile, slightly shrunken membrane, and the cleft cavity between the two claws is spherical, obovoid, or oblong. The petals are usually unilateral and erect in the open flower and narrowly clawed. The chromosome numbers of *Tarenaya* are  $2n = 20$  or 40 (Przywara, pers. obs.) or the specialized number 30 (Przywara, pers. obs.), apparently derived by chromosome fusion in one subgroup (Przywara, pers. obs.). *Tarenaya* is best represented in tropical lowlands and arid plateaus at medium elevations in northern and eastern South America (Eichler, 1865; Ruíz Zapata & Iltis, 1998) but ranges north to southern Mexico (Iltis, 1998) and the West Indies (Iltis, 1958, 2001). Although recognizing that some two dozen species presently assigned to *Cleome* have yet to be transferred to *Tarenaya* for the first time, only one such transfer is proposed here to ensure the name will be available for the upcoming volume 7 of the *Flora of North America*.

**1. *Tarenaya hassleriana*** (Chodat) Iltis, comb. nov.  
 Basionym: *Cleome hassleriana* Chodat, Bull. Herb. Boissier 6, App. 1: 12. 1898. TYPE: Paraguay. "Ad ripam fluminis pr. Apa, fl. Maj.," *E. Hassler* 162 (holotype, G-BOIS).

This is the common cultivar known as the spiny cleome (*Cleome spinosa*), but *Cleome spinosa* Jacquin is a different species Iltis treats as *Tarenaya spinosa* (Jacquin) Rafinesque. The latter is easily distinguished by the presence of minute glandular pubescence on the tips of the petals in bud and on the youngest capsules and white petals except for occasional intermediates between *T. spinosa* and *T. hassleriana* from the West Indies and Venezuela (Iltis, 1952), in which they are pinkish or purplish. In *T. hassleriana* the tips of the petals and capsules are glabrous, and the petals are pale to deep pink or purple or rarely white in horticultural varieties.

Native from northern Argentina (*Burkart* 8302, F, G) to Minas Gerais, Brazil (*Widgren* 786, BR, C, K, LE, M, PH, U), *Tarenaya hassleriana* occasionally escapes elsewhere, particularly throughout the eastern United States (Maryland: *Tidestrom* 14455, WIS) but also in Hawaii (Wagner et al., 1999), the West Indies (Adams, 1972), Asia (Bangladesh: *Hassan* 365, WIS), Africa (Engler, 1915; Kers, 1969; Jordaan, 2003), and Australia (Harden, 1990).

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